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The Magnavox Company

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Fort Wayne 4, Indiana
U . S . A

15 February 1960

The Magnavox Company
Suite 810
City Bank Building
1612 K Street, N. W.
Washington 6, D. C.

Attention: [redacted] STAT

Subject: [redacted] Proposal STAT
Magnacard Data Storage and
Retrieval System

Gentlemen:

Enclosed you will find three (3) copies of MRL Proposal Number P-670 for a Magnacard Data Storage and Retrieval System.

This proposal is designed to indicate alternative methods of accomplishing the task as outlined to us on February 4, 1960. These suggested methods are itemized below:

	Units One	Units Two to Five	Units Six or More
One Drum	$107,099	$ 79,748	$65,824
Two Drum	122,573	91,543	74,166
Four Drum	135,023	109,692	89,854
Four Drum with Sort Capability	137,333	112,002	91,799

The above costs include typewriter - punched paper tape input and typewriter - punched paper tape output. In the event that an external signal communication with the unit is required, and the teletype equipment is used, there will be no additional cost involved.

The cost of adding the register for comparing the entire index code is the same regardless of the unit used. This cost is $6,600 for five characters, $13,200 for twelve characters, and $19,800 for eighteen characters.

If it is desired to include the video-tube display, the additional cost will be $6,000 for thirty-two characters and $10,000 for the 400 character display.

The above quoted costs are based on a CPFF type contract and would be subject to a fixed fee of 7%. Work can begin immediately after receipt of contract, and delivery of the first unit could be expected within ten months.

It is quite possible that more detailed discussions may allow us to develop short-cuts which could materially reduce the equipment costs.

In the event that there are any questions, or if any clarification is needed, we shall be more than pleased to hear from you.

Very truly yours,

THE MAGNAVOX COMPANY

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Product Manager

DDJ/lml

PROPOSED MAGNACARD INSTALLATION

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MRL Proposal P-670

Magnavox Research Laboratories
Los Angeles, California

12 February 1960

Declassified in Part - Sanitized Copy Approved for Release 2012/09/11 : CIA-RDP78-03424A001400030001-4

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1.0 INTRODUCTION

A requirement of [redacted] is that data be recorded on unit documents in eraseable form. It is naturally understood that such machine parameters as pertain to reliability of equipment, ease of handling and speed of input-output devices play no small role as regards "desirable characteristics". STAT

The Magnavox Company has developed a new concept in data processing which will adequately meet the requirements set forth for [redacted] Using individual magnetic cards as the basic medium for its storage of information, this new concept, called Magnacard, was especially designed to meet such requirements. STAT

Machines have been developed by The Magnavox Company to select, collate, file and sort these magnetic cards at extremely high rates of speed. Magnacard has combined the high-speed advantages of electronic processing and the high-capacity of magnetic recording, with the ease of handling inherent in the use of individual unit records.

Magnacard equipment can be used either as a self-contained data handling system, or as an element in a large data processing system. The following sections describe several Magnacard handling machines and how they may be used in a small, self-contained system, meeting the requirements of [redacted] STAT
[redacted] STAT

2.0 ELEMENTS OF THE EQUIPMENT

2.1 THE MAGNETIC CARD

2.1.1 General Specifications

The basis of the Magnacard system is the use of individual magnetic cards for the storage of information. Measuring 1" x 3", the card consists of a Mylar base .005" thick with a .0005" iron oxide coating protected by a thin .0005" Mylar overlay. The card itself represents a significant part of the Magnacard development; it has been engineered, after extensive research and testing, to withstand heavy usage under severe operating conditions. Specifications call for an operating life of 20,000 passes through the handling equipment. For files of cards subjected to daily processing, this will mean a useful life on the order of several years.

2.1.2 Data Handling

Information is recorded and extracted from a card by techniques similar to those used with magnetic drums; i.e., using a sequence of magnetic spots recorded in tracks along the length of the card. Separate reading and recording heads are provided, each consisting of seventeen parallel tracks. Present recording provides a density of 100 bits to the inch along the length of the card. Since the technique of recording is magnetic, information can be added, erased, or changed as may be required by further processing.

2.1.3 Data Organization

In a self-contained system the data is recorded on the Magnacards in a serial-serial fashion; i.e., the bits representing one character are recorded sequentially in a given channel of the card. Each character consists of 8 binary bits—6 bits for the character code, one parity bit and a buffer

bit. The buffer bit is provided to prevent ambiguity in the transition between characters.

The capacity of each channel is therefore 32 characters. Seventeen information channels are available, thus providing a maximum card capacity of 544 characters.

2.2 THE MECHANICAL STRUCTURE

The mechanical handling equipment consists of a combination of a few basic elements—vacuum drums, feed-stack stations, transfer devices, hold stations, and reading and writing stations. These basic elements are combined to form the various handling units.

2.2.1 Vacuum Drum

The vacuum drums are the fundamental means for transporting cards; they are hollow, about 8 inches in diameter, and 1 inch high. Vacuum is applied continuously to the drum periphery through slots communicating with a hollow shaft, to provide a pressure differential across the surface. This difference in pressure holds the cards firmly on the periphery. The drum rotates at 12 revolutions per second, for a surface speed of 300" per second, and a resulting maximum card rate of 90 cards per second.

2.2.2 Feed-Stack Stations

Cards are successively fed onto the drums and stacked from them by the feed-stack stations. The stations are dual purpose, capable of either function; the reversal of a station from one status to the other is completely automatic. The stations can be retracted to allow a card to pass under. Feeding of cards can be either continuous at the maximum card rate, or intermittent with cards being released singly at rates up to the maximum card

rate. Feed control is accomplished by pneumatic means using a high pressure vacuum controlled by a fast response electrodynamic valve. (This valve is one of the most significant developments of the Magnacard program since it provides the capability of very high speed control of air flow. Its use to actuate the feed control is just one of the places in which this device is important. Others are described below.) The stations are capable of accepting card magazines for storage of the cards. These magazines have a capacity of 3,000 cards each. It is our understanding that this is sufficient capacity for Project 630; however, if greater storage is required, the magazines may be stored in file mechanisms with a capacity of 10 magazines.

2.2.3 Transfer Devices

Transfer Devices permit systems of drums and feed-stack stations to be designed with selective transfer of cards from one drum to another. These devices thus permit decisions to be made on cards and are the basis of the various sorting and collating operations. Cards are transferred from drum to drum by means of pneumatic jets controlled by the same type of high-speed electrodynamic valves used in the feed control. Selective transfer can be made at the free-running rate of 90 cards per second.

2.2.4 Hold Stations

Hold Stations are provided for temporarily stopping a card after it has been read, without removing it from the processing flow. This permits time for additional processing of data before writing on the card; it allows cards to be merged from two separate feeding stations into a single stacking station; and it permits other cards to be transferred onto the same drum for simultaneous circulation. The same pneumatic control valve is used in the hold station as that used in the feed control.

3.0 EQUIPMENT SPECIFICATIONS

3.1 THE TWO-DRUM UNIT

3.1.1 Mechanical Data

The two-drum unit consists of two transport drums, one read head, one write head, one transfer jet, and two feed-stack stations. The mechanical structure of a two-drum unit is shown in Figure 1.

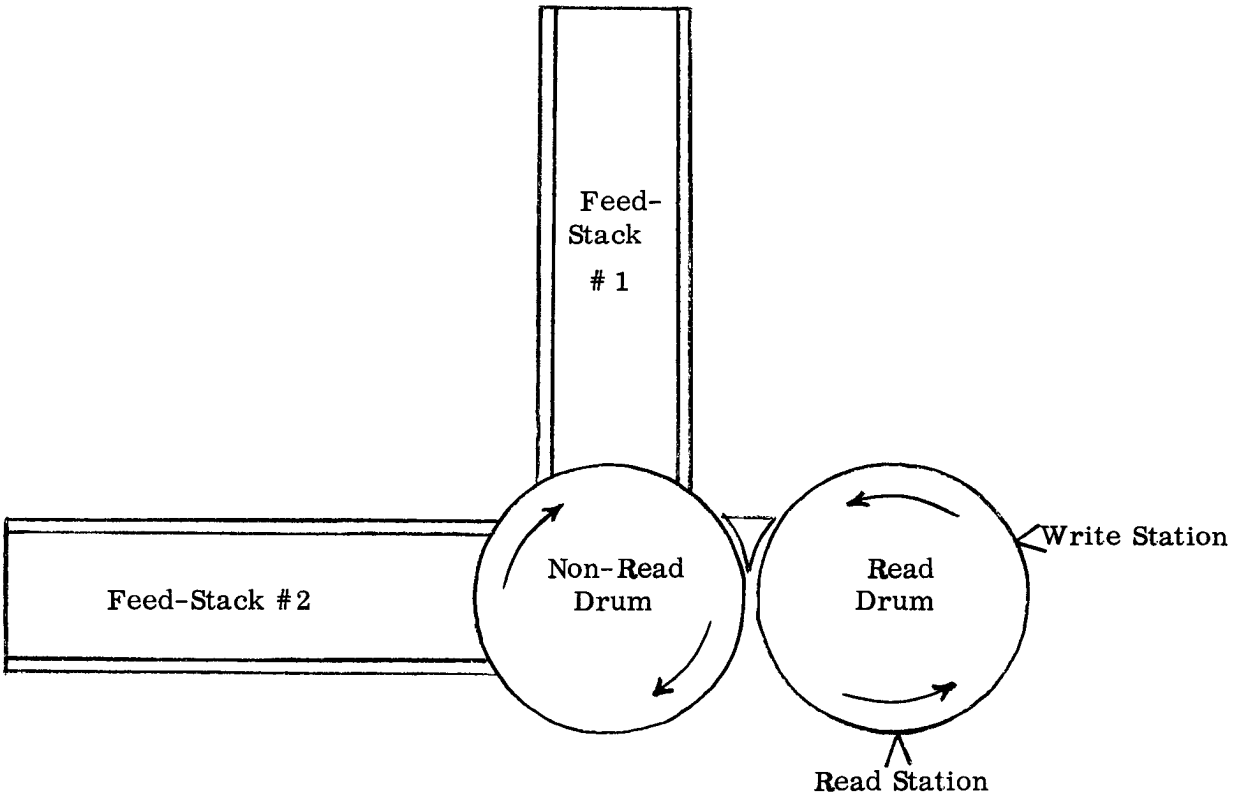
3.1.2 Functional Data

3.1.2.1 Input

The information to be recorded on the cards can be input from either a punched paper tape or a keyboard. In the input mode a Magnacard is released from station 1 (see Figure 1), transferred to the read-write drum, and allowed to circulate on the read-write drum. As the card passes under the write head, the last character read from the tape is recorded on the card.

The necessary counters are provided to count the number of characters recorded in a channel and the number of channels recorded on a card.

When one channel has been completely recorded, the next channel is automatically selected; when one card is completed, it is automatically transferred back to the non-read drum and stacked in station 2. Codes are available for stepping to the next channel after recording any number of characters and for returning a card to the non-read drum whenever all the desired information has been recorded on a given card.



TWO-DRUM HANDLING UNIT

Figure 1.

3.1.2.2 File Search

Using the two-drum unit, a file search may be performed in either of two ways. The search may be made a character per revolution or a compare register may be provided for comparing on all characters during a single pass under the read head.

3.1.2.2.1 Single Character Comparison: To perform a one character per revolution file search, the one character register presently provided will be used. The high-order character of the desired index code will be read from a paper tape or keyboard and stored in this register.

One Magnacard will be released from station one and transferred to the read drum. The first time the card passes under the read head, the high order character of the index code on the card will be compared to the character stored in the register. If the characters are not equal, the card is returned to the non-read drum and stacked in station two. If these characters are equal, the next character is read in from the tape (or keyboard), stored in the register and compared to the next character on the Magnacard.

This process is continued until one of the characters of the index code is not equal or until all characters are equal and thus the desired card is found. After a card has been selected, it may continue to circulate and its contents output by means of the typewriter, the paper tape, or the typotron tube. If desired, the information on this card may be further changed by additional processing.

The criteria involved in this method of operation is that of either storing all the characters in the index code or re-reading the tape after each card has been processed. As regards re-reading the tape, the following alternate methods may be used:

a. The tape can be back-spaced to a stop code after each non-compare;

b. As each character is read, another tape may be punched and the new tape read after each non-compare;

c. The tape may be looped and skip to the stop code after each non-compare;

d. The comparison on a new card may be started on the next character after the character which did not compare on the previous card (the high order character is compared after the low order character) and a counter (5, 10, or 15 digit) provided to count the number of equal characters obtained.

Without having some indication of the distribution of characters within the index code, it is difficult to estimate the rate at which the cards may be searched. The time required for each revolution of the card is 83 milliseconds.

3.1.2.2.2 Multi-Character Comparison: By providing a register capable of storing and comparing the required number of characters in a single pass, the entire comparison may be made in a single revolution.

In this mode of operation an entire index code will be read into the compare register from the tape or keyboard and stored until the correct card has been found or the entire file searched.

On the two-drum unit the file may be searched at the rate of 25 cards per second.

3.1.2.3 Output

The output function on the two-drum array is quite similar to the input function. A card is released from station 1, transferred to the read drum and the characters read one by one as the card passes under the read head. As each character is read it is printed on the typewriter or punched on the paper tape.

3.2 FOUR-DRUM UNIT

3.2.1 Mechanical Data

The four-drum unit consists of four transport drums, two read heads, one write head, two hold stations, four or five feed-stack stations. Figure 2 shows the mechanical structure of a four-drum handling unit with five feed-stack stations.

3.2.2 Functional Data

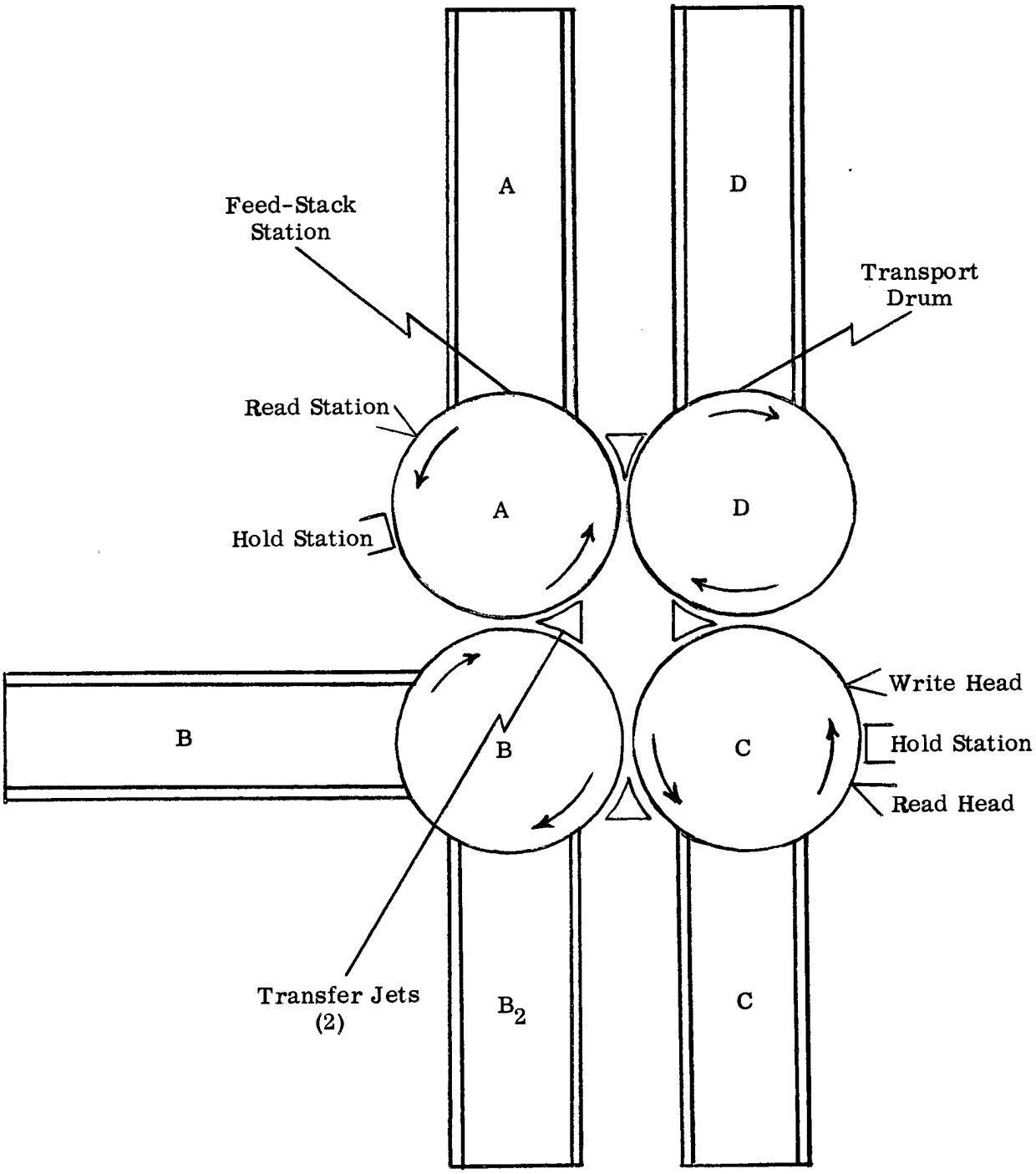
3.2.2.1 Input

The input operation is similar to that described on the two-drum unit. The cards are released from station A, transferred to the B drum and then to the C drum, where they are allowed to circulate. The data is recorded as the card passes under the write head on the C drum. After all the data has been recorded on a card, it is transferred to the D drum and stacked on the D station.

3.2.2.2 File Search

3.2.2.2.1 Single Character Comparison: The cards may be searched one character per revolution in a manner similar to that described in Section 3.1.2.1. The cards would be released from the A station, transferred to the B drum, and then to the C drum. The comparisons would then be made on the C drum.

3.2.2.2.2 Search by Sorting: A deck of Magnacards may be searched by a series of sorting passes. For example, all the cards to be searched may be stored in station A. These cards can then be released in the free-running mode at the rate of 90 cards per second. One character will be read from each card as it passes under the read head on the A drum. If this character satisfies the requirement of the desired index code, the card will be transferred to the B drum, then to the C drum and stacked in station C. If this character does



FOUR-DRUM UNIT

Figure 2.

not satisfy the requirement of the desired index code, the card is transferred to the B drum and stacked in station B_2. The cards in station C are then released at the free-running rate and compared on the second character. The cards which satisfy the search are stacked in station A; those which do not, in station D. The process is repeated until the search has been performed over the number of characters in the index code.

As we do not have any data relative to the distribution of the characters in the index code, we cannot estimate the number of cards to be read on each successive pass; however, the number of cards is certain to decrease very rapidly. If there were an equal distribution of characters in a given character position, each pass would eliminate 97% of the remaining cards.

3.2.2.2.3 Multi-Character Comparison: By providing the compare register described in Section 3.1.2.2.2, the entire index code can be compared as each card passes under the read head. In operation, the entire deck will be stored in station A. The cards are free run, read, and compared to the contents of the compare register. The unselected cards are transferred to either the B drum or the D drum and stacked there. Whenever the desired index code is found, the card is transferred to the B drum, then to the C drum where it is allowed to circulate. As the card circulates on the C drum, its contents may be output to either the typewriter or the paper tape punch, or—if desired—the contents of the card may be changed.

3.2.2.3 Output

In the output mode of operation, a card is released from station A, transferred to B, then to C and allowed to circulate on the C drum. Each time the card passes the read head a character is read out on the typewriter or the paper tape punch.

3.2.2.4 Binary Sort

Any sequential arrangement of a deck of Magnacards may be accomplished by binary sorting. In this operation a single deck of randomly ordered cards is sorted over n binary digits by dividing the deck n times, once for each bit in increasing order of significance. The unordered deck is placed in station A. The cards are free-run, read, and stacked in either station B or C, depending on the least significant digit. The cards are next fed from C (least significant digit 0) and stacked in either A or D, depending on the next most significant digit. When C is exhausted, cards are fed from B (least significant digit 1) and also stacked on A or D, and so on until n passes have been completed. Cards may be sorted at the rate of 90 per second.

3.3 ONE-DRUM UNIT

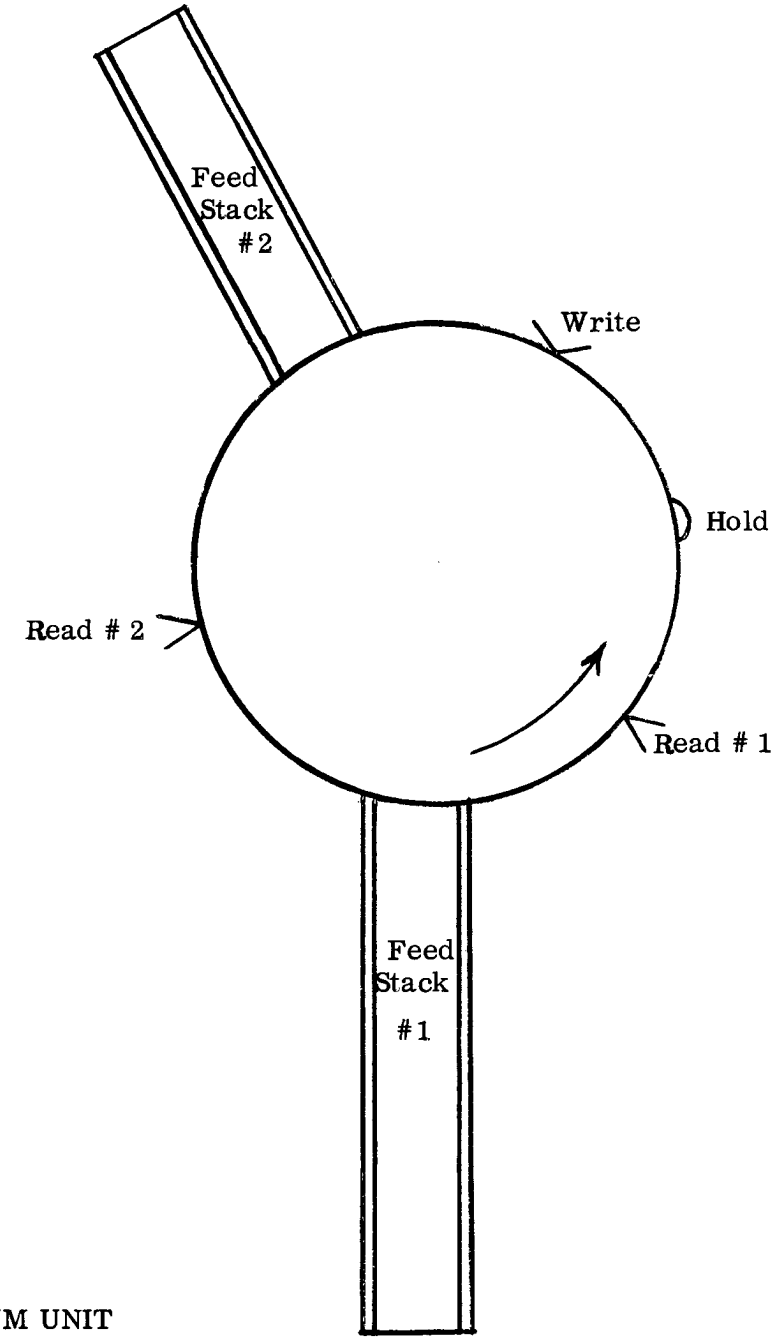
3.3.1 Mechanical Data

The configuration of the one-drum handling unit is shown in Figure 3. This unit consists of a single drum transport with two reversible and retractable feed-stack stations, two read heads, one write head and one hold station.

3.3.2 Functional Data

3.3.2.1 Input

The data to be input is read from the paper tape or keyboard. A card is released from station 1 and held at the hold station, while the feed-stack stations are retracted. After the stations are retracted, the card is allowed to circulate on the drum and data is recorded each time the card passes under the write head. After all the data has been recorded, the card is again held at the hold station and the stations reinserted in their original configuration.



ONE-DRUM UNIT

Figure 3.

3.3.2.2 File Search

3.3.2.2.1 Single Character Comparison: The Magnacards to be searched will be contained in station 1. The first character of the desired index code will be read into the register either from the paper tape or from the keyboard. One card will be released from station one and one character of its index code read at the first read station. If the character does not equal the character read from the tape, the card will continue around the drum periphery and be stacked in station 2 as the next card is released. If the characters are equal, the card will be held at the hold station while the feed-stack stations are retracted. After the stations are retracted, the next character is read from the tape and the card is released from the hold station and allowed to circulate on the drum. When the card again passes under the read head, the next characters are compared. If these characters are equal, the process is continued until one character is found unequal or until all characters of the index codes are equal. Whenever one character is found unequal, the card is again held, the stations inserted, and the next card released.

3.3.2.2.2 Multi-Character Comparison: The compare register described in Section 3.1.2.2.2 can also be used with the one-drum machine. The cards are released singly from feed-stack station one, read at read station 1, and the entire index code compared with the desired index code which was read in from either the punched paper tape or the keyboard. If the index codes are unequal, the card is stacked in station 2 and the next card released from station 1. If the index codes are equal, the card is held at the hold station, the feed-stack stations are retracted and the card is permitted to circulate on the drum for either an output operation or a change of the data. The file may be searched on the one-drum unit at the rate of 50 cards per second.

3.3.2.3 Output

For the output mode, station 1 is in feed and station 2 in stack configuration. A card is released from station 1, one character is read and either printed on the typewriter or punched on the paper tape, and the card held at the hold station while the feed-stack stations are retracted. The card is then released from the hold station and allowed to circulate on the drum. Each time the card passes under read station 1, one character is read and either printed or punched. When all the data has been printed or punched, the card is again held at the hold station, the stations re-inserted, the card released from the hold station and stacked in station two.

4.0 VIDEO-TUBE DISPLAY

The digital data recorded on the Magnacard may be translated to a visual read-out using the Typotron tube developed by Hughes Aircraft. This read-out may be either 32 characters (one Magnacard channel) or 400 characters (nearly the entire capacity of a Magnacard). The display of 400 characters would be available in less than two seconds.

5.0 SUMMARY

Either the one, two or four-drum unit described in the preceding sections will satisfy the requirements of [redacted] It STAT is our opinion, however, that the four-drum unit is the best suited for this operation as it has the ability to re-arrange the cards and provides a much faster search rate.

The equipment described is capable of controlling all the input-output units mentioned--Teletype Tape Punch and Page Printer, IBM Typewriter, Soroban Punch and Reader, or Flexowriter--at their maximum rates up to 12 characters per second.

The ability to handle files without re-writing--except as desired--, the high-speed card re-arrangement capability, the communication facility afforded by the transport mechanism, all combine to produce a powerful new data processing tool.